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# Milford Reservoir, Clay and Geary Counties, Kansas

National Eutrophication Survey, Corvallis, Oreg

Prepared for

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# U.S. ENVIRONMENTAL PROTECTION AGENCY
# NATIONAL EUTROPHICATION SURVEY
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REPORT

ON

MILFORD RESERVOIR

CLAY AND GEARY COUNTIES

KANSAS

EPA REGION VII

WORKING PAPER NO. 519

WITH THE COOPERATION OF THE

KANSAS DEPARTMENT OF HEALTH AND ENVIRONMENT

AND THE

KANSAS NATIONAL GUARD

APRIL, 1977

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16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

17. KEY WORDS AND DOCUMENT ANALYSIS

| a. DESCRIPTORS | b. IDENTIFIERS/OPEN ENDED TERMS | c. COSATI Field/Group |
|---|---|---|
| eutrophication<br>lakes<br>nutrients<br>phosphorus<br>nitrogen<br>loading | | 05B<br>05C |

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# FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs.

## OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

## ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

## LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's freshwater lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Kansas State Department of Health and Environment for professional involvement, to the Kansas National Guard for conducting the tributary sampling phase of the Survey, and to those Kansas wastewater treatment plant operators who voluntarily provided effluent samples and flow data.

The staff of the Kansas Division of Environmental Health provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary reports, and provided critiques most useful in the preparation of this Working Paper series.

Major General Edward R. Fry, the Adjutant General of Kansas, and Project Officer Colonel Albin L. Lundquist, who directed the volunteer efforts of the Kansas National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

# NATIONAL EUTROPHICATION SURVEY

## STUDY RESERVOIRS

## STATE OF KANSAS

| NAME | COUNTY |
|---|---|
| Cedar Bluff | Trego |
| Council Grove | Morris |
| Elk City | Montgomery |
| Fall River | Greenwood |
| John Redmond | Coffey, Lyon |
| Kanopolis | Ellsworth |
| Marion | Marion |
| Melvern | Osage |
| Milford | Clay, Geary |
| Norton | Norton |
| Perry | Jefferson |
| Pomona | Osage |
| Toronto | Greenwood, Woodson |
| Tuttle Creek | Marshall, Pottawatomie, Riley |
| Wilson | Russell |

# MILFORD RESERVOIR
## STORET NO. 2009

## I. CONCLUSIONS

### A. Trophic Condition:

Survey data indicate that Milford Reservoir is eutrophic. It ranked thirteenth in overall trophic quality when the 15 Kansas reservoirs sampled in 1974 were compared using a combination of six lake parameters*. Eleven of the reservoirs had less median total phosphorus, 11 had less and one had the same median dissolved phosphorus, nine had less median inorganic nitrogen, 12 had less mean chlorophyll a, and three had greater mean Secchi disc transparency. Depression of dissolved oxygen with depth occurred at stations 1 and 3 in June.

Survey limnologists did not observe macrophytes or surface concentrations of algae but noted turbid water in June and October at sampling station 4.

### B. Rate-Limiting Nutrient:

The algal assay results indicate that Milford Reservoir was phosphorus limited at the time the assay sample was collected (04/11/74).

The reservoir data indicate phosphorus limitation at all sampling times.

* See Appendix A.

C. Nutrient Controllability:

1. Point sources--Point sources contributed 3.2% of the total phosphorus input to Milford Reservoir during the sampling year. The City of Clyde added 0.3% of the total; Concordia, 1.2%; Morganville, <0.1%; Wakefield, 0.2%; Clay Center, 1.3%; and Clifton, 0.2%.

The present phosphorus loading of 6.79 g/m$^2$/yr is nearly eleven times that proposed by Vollenweider (Vollenweider and Dillon, 1974) as a eutrophic loading (see page 13). Because of the relatively small contributions, it is not likely that point-source phosphorus control would result in any significant improvement in the trophic condition of Milford Reservoir.

2. Non-point sources--The contribution of non-point sources amounted to 96.8% of the total phosphorus load to Milford Reservoir during the sampling year. The Republican River contributed 90.8% of the total; Five Creeks, 1.3%; Mall Creek, 0.5%; and the ungaged tributaries added an estimated 3.9%.

The phosphorus export rates of the Republican River, Five Creeks, and Mall Creek were 6, 30, and 26 kg/km$^2$/yr, respectively (see page 12). These rates compare well to those of three tributaries of nearby Council Grove Reservoir* (60, 41, and 6 kg/km$^2$/yr, respectively).

* Working Paper No. 512.

## II. RESERVOIR AND DRAINAGE BASIN CHARACTERISTICS†

### A. Morphometry††:

1. Surface area: 65.51 kilometers².
2. Mean depth: 7.8 meters.
3. Maximum depth: 21.3 meters.
4. Volume: 511.902 x $10^6$ $m^3$.
5. Fourteen-year median hydraulic retention time: 285 days.

### B. Tributary and Outlet:
(See Appendix C for flow data)

1. Tributaries -

| Name | Drainage Area ($km^2$)* | Mean Flow ($m^3$/sec)* |
|---|---|---|
| Republican River | 63,963.0 | 23.630 |
| Five Creeks | 179.7 | 0.570 |
| Mail Creek | 54.0 | 0.263 |
| Minor tributaries & immediate drainage - | 604.5 | 2.830 |
| Totals | 64,402.0 | 27.193 |

2. Outlet -

| | | |
|---|---|---|
| Republican River | 64,465.1** | 16.170 |

### C. Precipitation*,***:

1. Year of sampling: 66.6 centimeters.
2. Mean annual: 67.7 centimeters.

† Table of metric conversions--Appendix B.
†† Kring, 1977.
* For limits of accuracy, see Working Paper No. 175, "...Survey Methods, 1973-1976".
** Includes area of reservoir.
*** See Working Paper No. 175.

## III. WATER QUALITY SUMMARY

Milford Reservoir was sampled three times during the open-water season of 1974 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from a number of depths at four stations on the reservoir (see map, page v). During each visit, a single depth-integrated (4.6 m or near bottom to surface) sample was composited from the stations for phytoplankton identification and enumeration; and during the first visit, a single 18.9-liter depth-integrated sample was composited for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analysis. The maximum depths sampled were 18.0 meters at station 1, 14.0 meters at station 2, 10.1 meters at station 3, and 4.6 meters at station 4.

The sampling results are presented in full in Appendix B and are summarized in the following table.

| | | |

B. Biological Characteristics:

1. Phytoplankton -

| Sampling Date | Dominant Genera | Algal Units per ml |
|---|---|---|
| 04/11/74 | 1. Stephanodiscus sp. | 20,759 |
| | 2. Chroomonas sp. | 1,601 |
| | 3. Ankistrodesmus sp. | 450 |
| | 4. Cryptomonas sp. | 226 |
| | 5. Nitzschia sp. | 135 |
| | Other genera | 180 |
| | Total | 23,650 |
| 06/26/74 | 1. Centric diatoms | 284 |
| | 2. Microcystis sp. | 236 |
| | 3. Scenedesmus sp. | 189 |
| | 4. Cryptomonas sp. | 142 |
| | 5. Nitzschia sp. | 142 |
| | Other genera | 379 |
| | Total | 1,372 |
| 10/03/74 | 1. Stephanodiscus sp. | 6,102 |
| | 2. Chroomonas sp. | 790 |
| | 3. Skeletonema sp. | 740 |
| | 4. Dactylococcopsis sp. | 296 |
| | 5. Scenedesmus sp. | 197 |
| | Other genera | 395 |
| | Total | 7,600 |

B. Chlorophyll a -

| Sampling Date | Station Number | Chlorophyll a (ug/l) |
|---|---|---|
| 04/11/74 | 1 | 24.6 |
| | 2 | 29.4 |
| | 3 | 25.7 |
| | 4 | 30.7 |
| 06/26/74 | 1 | 1.1 |
| | 2 | 4.3 |
| | 3 | 7.9 |
| | 4 | 16.1 |
| 10/03/74 | 1 | 0.1 |
| | 2 | 16.6 |
| | 3 | 15.6 |
| | 4 | 61.1 |

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

| Spike (mg/l) | Ortho P Conc. (mg/l) | Inorganic N Conc. (mg/l) | Maximum yield (mg/l-dry wt.) |
|---|---|---|---|
| Control | 0.025 | 0.466 | 12.6 |
| 0.050 P | 0.075 | 0.466 | 16.3 |
| 0.050 P + 1.0 N | 0.075 | 1.466 | 25.2 |
| 1.0 N | 0.025 | 1.466 | 13.3 |

2. Discussion -

The control yield of the assay alga, Selenastrum capricornutum, indicates that the potential primary productivity of Milford Reservoir was high at the time the sample was taken (04/11/74). There was a significant increase in yield when phosphorus alone was added, but no such increase occurred when only nitrogen was added. These results indicate the reservoir was phosphorus limited at that time.

The reservoir data also indicate phosphorus limitation. The mean inorganic nitrogen to orthophosphorus ratios were 16 to 1 in April, 19 to 1 in June, and 49 to 1 in October; and phosphorus limitation would be expected.

## IV. NUTRIENT LOADINGS
(see Appendix E for data)

For the determination of nutrient loadings, the Kansas National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v), except for the months months of June and July when two samples were collected at most of the sites. Sampling was begun in October, 1974, and was completed in September, 1975.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Kansas District Office of the U.S. Geological Survey for the tributary sites nearest the reservoir.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a U.S. Geological Survey computer program for calculating stream loadings*. Nutrient loads shown are those measured minus point-source loads, if any.

Nutrient loads for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated using the means of the nutrient loads, in kg/km$^2$/year, at stations B-1 and D-1 and multiplying the means by the ZZ area in km$^2$.

The operators of the Clifton, Clyde, Concordia, and Morganville wastewater treatment plants provided monthly effluent samples and corresponding flow data. The operators of the Clay Center and Wakefield wastewater treatment plants provided monthly effluent samples

* See Working Paper No. 175.

but could not provide flow data. Therefore, nutrient loads from these two sources were estimated at 1.134 kg P and 3.401 kg N/capita/year, and flows were estimated at 0.3785 $m^3$/capita/day.

A. Waste Sources:

1. Known municipal* -

| Name | Pop. Served | Treatment | Mean Flow ($m^3$/d) | Receiving Water |
|---|---|---|---|---|
| Clay Center | 5,093 | prim. clarifier | 1,927.7 | Republican River |
| Clifton | 714 | Imhoff tank | 304.7 | Republican River |
| Clyde | 963 | stab. pond | 829.5 | Republican River |
| Concordia | 7,680 | stab. pond | 1,063.7 | Republican River |
| Morganville | 252 | stab. pond | 96.9 | Buffalo Creek/ Republican River |
| Wakefield | 730 | stab. pond | 276.3 | Milford Reservoir |

2. Known industrial - None

* Treatment plant questionnaires.

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

| Source | kg P/ yr | % of total |
|---|---|---|
| a. Tributaries (non-point load) - | | |
| Republican River | 380,025 | 90.0 |
| Five Creeks | 5,355 | 1.3 |
| Mall Creek | 2,125 | 0.5 |
| b. Minor tributaries & immediate drainage (non-point load) - | 16,925 | 3.9 |
| c. Known municipal STP's - | | |
| Clay Center | 5,775 | 1.3 |
| Clifton | 1,005 | 0.2 |
| Clyde | 1,200 | 0.3 |
| Concordia | 6,145 | 1.2 |
| Morganville | 75 | <0.1 |
| Wakefield | 830 | 0.2 |
| d. Septic tanks - Unknown | ? | ? |
| e. Known industrial - None | - | - |
| f. Direct precipitation* - | 1,105 | 0.3 |
| Total | 420,565 | 100.0 |

2. Outputs -

Reservoir outlet - Republican River 40,260

3. Net annual P accumulation - 380,305 kg.

* See Working Paper No. 175.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

| Source | kg N/yr | % of total |
|---|---|---|
| a. Tributaries (non-point load) - | | |
| Republican River | 1,884,190 | 79.7 |
| Five Creeks | 66,445 | 2.8 |
| Mall Creek | 39,140 | 1.7 |
| b. Minor tributaries & immediate drainage (non-point load) - | 256,120 | 10.9 |
| c. Known municipal STP's - | | |
| Clay Center | 17,320 | 0.8 |
| Clifton | 3,445 | 0.2 |
| Clyde | 2,710 | 0.1 |
| Concordia | 17,365 | 0.6 |
| Morganville | 240 | <0.1 |
| Wakefield | 2,485 | 0.1 |
| d. Septic tanks - Unknown | ? | ? |
| e. Known industrial - None | - | - |
| f. Direct precipitation* - | 68,155 | 2.9 |
| Total | 2,359,615 | 100.0 |

2. Outputs -

Reservoir outlet - Republican River 1,327,935

3. Net annual N accumulation - 1,031,680 kg.

D. Non-point Nutrient Export by Subdrainage Area:

| Tributary | kg P/km²/yr | kg N/km²/yr |
|---|---|---|
| Republican River | 6 | 30 |
| Five Creeks | 30 | 370 |
| Mall Creek | 26 | 484 |

* See Working Paper No. 175.

E. Mean Nutrient Concentrations in Ungaged Streams:

| Tributary | Mean Total P Conc. (mg/l) | Mean Total N Conc. (mg/l) |
|---|---|---|
| Unnamed Stream C-1 | 0.219 | 2.304 |
| Unnamed Stream F-1 | 1.176 | - |
| Unnamed Stream G-1 | 0.060 | 0.170 |

F. Yearly Loads:

In the following table, the existing phosphorus loadings are compared to those proposed by Vollenweider (Vollenweider and Dillon, 1974). Essentially, his "dangerous" loading is one at which the receiving water would become eutrophic or remain eutrophic; his "permissible" loading is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic loading would be considered one between "dangerous" and "permissible".

Note that Vollenweider's model may not be applicable to water bodies with short hydraulic retention times.

| | Total Phosphorus | | Total Nitrogen | |
|---|---|---|---|---|
| | Total | Accumulated | Total | Accumulated |
| grams/$m^2$/yr | 6.79 | 6.02 | 37.4 | 16.3 |

Vollenweider phosphorus loadings ($g/m^2/yr$) based on mean depth and 14 year median hydraulic retention time of Milford Reservoir:

| | |
|---|---|
| "Dangerous" (eutrophic loading) | 0.62 |
| "Permissible" (oligotrophic loading) | 0.31 |

## V. LITERATURE REVIEWED

Kring, R. Lynn, 1977. Personal communication (revised reservoir morphometry). KS Dept. of Health & Environment, Topeka.

Vollenweider, R. A., and P. J. Dillon, 1974. The application of the phosphorus loading concept to eutrophication research. Natl. Res. Council of Canada Publ. No. 13690, Canada Centre for Inland Waters, Burlington, Ontario.

# VI. APPENDICES

## APPENDIX A

## LAKE RANKINGS

LAK. DATA TO BE KEED >> REMOVES

| LAKE CODE | LAKE NAME | [illegible] TOTAL P | [illegible] INDIS P | SUR- [illegible] SE | [illegible] CHLPA | IS- [illegible] | [illegible] [illegible] P |
|---|---|---|---|---|---|---|---|
| 2801 | CEDAR BLUFF RESERVOIR | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 2802 | COUNCIL GROVE | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 2803 | ELK CITY | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 2804 | FALL RIVER RESERVOIR | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 2805 | JOHN REDMOND RESERVOIR | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 2806 | KANOPOLIS RESERVOIR | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 2807 | MARION RESERVOIR | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 2808 | MELVERN RESERVOIR | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 2809 | MILFORD RESERVOIR | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 2810 | NORTON RESERVOIR | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 2811 | PERRY RESERVOIR | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 2812 | POMONA RESERVOIR | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 2813 | TORONTO RESERVOIR | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 2814 | TUTTLE CREEK RESERVOIR | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 2815 | WILSON RESERVOIR | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |

[illegible]

[illegible]

[illegible]

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

| LAKE CODE | LAKE NAME | MEDIAN TOTAL P | MEDIAN INORG N | 500-MEDIAN SECC | MEDIAN CHLOPH | 25-MEDIAN DO | MEDIAN DIOX DAYMAX P | INDEX NO |
|---|---|---|---|---|---|---|---|---|
| 2501 | CEDAR BLUFF RESERVOIR | 100 ( 144) | 100 ( 144) | 100 ( 144) | 93 ( 133) | 57 ( 81) | 89 ( 127) | 529 |
| 2502 | DANIEL CREEK | 29 ( 41) | 29 ( 41) | 36 ( 51) | 43 ( 61) | 64 ( 91) | 29 ( 41) | 236 |
| 2503 | ELK CITY | 85 ( 121) | 50 ( 71) | 7 ( 11) | 100 ( 144) | 7 ( 11) | 100 ( 144) | 358 |
| 2504 | FALL RIVER RESERVOIR | 57 ( 81) | 57 ( 81) | 14 ( 21) | 71 ( 100) | 79 ( 113) | 50 ( 71) | 328 |
| 2505 | JOHN REDMOND RESERVOIR | 14 ( 21) | 3 ( 11) | 8 ( 11) | 50 ( 71) | 93 ( 133) | 7 ( 11) | 196 |
| 2506 | KANOPOLIS RESERVOIR | 43 ( 61) | 43 ( 61) | 29 ( 41) | 21 ( 31) | 71 ( 100) | 64 ( 91) | 271 |
| 2507 | MARION RESERVOIR | 64 ( 91) | 64 ( 91) | 43 ( 61) | 29 ( 41) | 86 ( 123) | 71 ( 100) | 357 |
| 2509 | MILFORD RESERVOIR | 79 ( 113) | 82 ( 117) | 86 ( 123) | 0 ( 01) | 3 ( 01) | 79 ( 113) | 329 |
| 2510 | MILTON RESERVOIR | 21 ( 31) | 36 ( 51) | 79 ( 113) | 14 ( 21) | 50 ( 71) | 14 ( 21) | 214 |
| 2511 | NORTON RESERVOIR | 7 ( 11) | 93 ( 133) | 64 ( 91) | 7 ( 11) | 100 ( 144) | 21 ( 31) | 292 |
| 2512 | PERRY RESERVOIR | 50 ( 71) | 10 ( 21) | 57 ( 81) | 86 ( 123) | 25 ( 31) | 43 ( 61) | 276 |
| 2513 | POMONA RESERVOIR | 71 ( 100) | 7 ( 11) | 50 ( 71) | 64 ( 91) | 36 ( 51) | 36 ( 51) | 267 |
| 2514 | TORONTO RESERVOIR | 36 ( 51) | 71 ( 100) | 21 ( 31) | 79 ( 113) | 36 ( 51) | 57 ( 81) | 303 |
| 2515 | TURTLE CREEK RESERVOIR | 0 ( 01) | 10 ( 21) | 71 ( 100) | 36 ( 51) | 14 ( 21) | 0 ( 01) | 130 |
| 2516 | WILSON RESERVOIR | 93 ( 133) | 82 ( 117) | 93 ( 133) | 57 ( 81) | 25 ( 31) | 82 ( 117) | 429 |

APPENDIX B

CONVERSION FACTORS

## CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x $8.107 \times 10^{-4}$ = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

# APPENDIX C

## TRIBUTARY FLOW DATA

[illegible]

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# APPENDIX D

# PHYSICAL and CHEMICAL DATA

[illegible]

# APPENDIX E

## TRIBUTARY AND WASTEWATER TREATMENT PLANT DATA

[redacted]

[illegible]

[illegible]

| [illegible] | | | | | | | |
|---|---|---|---|---|---|---|---|
| [illegible] | | | | | | | |
| [illegible] | | | | | | | |
| [illegible] | | | | | | | |

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| DATE | TIME | DEPTH | | | | | |
|---|---|---|---|---|---|---|---|
| MO | DY | FEET | | | | | |
| 10 | 1987 | FEET | | | | | |
| [illegible] | 13 | 35 | 0.1117 | 0.7991 | 1.0240 | 0.6230 | 0.1231 |
| [illegible] | 14 | 05 | 0.2388 | 1.5303 | 1.9786 | 0.6035 | 0.1314 |
| [illegible] | | | 0.2857 | 1.4454 | 0.4955 | 1.6946 | 0.6874 |
| [illegible] | 13 | 45 | 0.1996 | 0.5316 | 1.1134 | 1.6625 | 0.6130 |
| [illegible] | 14 | 15 | 0.2988 | 0.4488 | 1.6814 | 1.6214 | 0.6340 |
| [illegible] | 15 | 45 | 1.1774 | 2.4455 | 1.2134 | 1.6114 | 1.6134 |
| [illegible] | 11 | 18 | 0.2134 | 3.3388 | 1.1141 | 0.6295 | 0.6341 |
| [illegible] | 13 | 12 | 0.2558 | 1.1758 | 0.8172 | 0.6158 | 0.6133 |
| [illegible] | 11 | 18 | 0.1388 | 1.4488 | 0.1339 | 0.6133 | 0.6138 |
| [illegible] | 11 | 18 | 0.1145 | | 0.6175 | 0.6146 | |
| [illegible] | 10 | 23 | 0.1146 | 0.4181 | 0.8532 | 1.1719 | 0.6161 |
| [illegible] | 11 | 19 | 0.1145 | 0.1558 | 0.6146 | 0.6158 | 0.6148 |
| [illegible] | 10 | 08 | 0.1146 | 0.1558 | 0.1941 | 0.8158 | 0.6156 |

[illegible]

| DATE | TIME | DEPTH | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
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| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |

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| [illegible] | | | | | | | | |
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| DATE | TIME | DEPTH | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
|---|---|---|---|---|---|---|---|---|---|
| FROM | OF | | DISSOLVED | % | TOTAL | [illegible] | | RATE | [illegible] |
| TO | DAY | FEET | MG/L | MG/L | MG/L | MG/L P | MG/L P | [illegible] | [illegible] |
| 75/01/06- | 10 | 00 | | | | | | | |
| CHTD- | | | 0.240 | 6.400 | 0.240 | 2.300 | 2.500 | 2.00 | 0.033 |
| 75/01/06- | 15 | 00 | | | | | | | |
| 75/02/04- | 09 | 00 | | | | | | | |
| CHTD- | | | 0.240 | 7.100 | 0.190 | 2.200 | 2.400 | 0.020 | 0.035 |
| 75/02/04- | 15 | 00 | | | | | | | |
| 75/03/04- | 09 | 00 | | | | | | | |
| CHTD- | | | 0.240 | 7.200 | 0.050 | 2.500 | 2.400 | 0.00 | 0.030 |
| 75/03/04- | 15 | 00 | | | | | | | |
| 75/04/07 | 09 | 00 | | | | | | | |
| CHTD- | | | 0.190 | 6.900 | 0.140 | 1.400 | 2.700 | 0.002 | 0.005 |
| 75/04/07 | 15 | 00 | | | | | | | |
| 75/05/06- | 09 | 00 | | | | | | | |
| CHTD- | | | 0.300 | 6.400 | 0.200 | 1.200 | 1.700 | | 0.009 |
| 75/05/06- | 15 | 00 | | | | | | | |
| 75/06/03 | 09 | 00 | 0.200 | 11.000 | 0.050+ | 1.400 | 2.900 | 0.050 | 0.009 |
| 75/07/07- | 09 | 00 | | | | | | | |
| CHTD- | | | 0.050 | 3.700 | 0.025+ | 1.100 | 1.400 | 0.020 | 0.020 |
| 75/07/07- | 15 | 00 | | | | | | | |
| 75/08/03 | 09 | 00 | | | | | | | |
| CHTD- | | | 0.025 | 4.200 | 0.025+ | 1.200 | 1.575 | 0.020 | 0.030 |
| 75/08/03 | 15 | 00 | | | | | | | |
| 75/09/04 | 09 | 00 | | | | | | | |
| CHTD- | | | 0.075 | 4.300 | 0.025+ | 1.300 | 2.000 | 0.042 | 0.040 |
| 75/09/04- | 15 | 00 | | | | | | | |
| 75/10/07- | 09 | 00 | | | | | | | |
| CHTD- | | | 0.200 | 5.700 | 0.025 | 1.600 | 1.500 | 0.020 | 0.042 |
| 75/10/07- | 15 | 00 | | | | | | | |
| 75/11/04- | 09 | 00 | | | | | | | |
| CHTD- | | | 0.115 | 5.400 | 0.025 | 1.500 | 2.400 | 0.020+ | 0.030 |
| 75/11/04- | 15 | 00 | | | | | | | |
| 75/12/09 | 09 | 00 | | | | | | | |
| CHTD- | | | 0.425 | 5.400 | 0.240 | 2.200 | 2.700 | 0.040 | 0.042 |
| 75/12/09 | 15 | 00 | | | | | | | |

[illegible]

[illegible]

[illegible]

| DATE FROM TO | TIME OF DAY | DEPTH FEET | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
|---|---|---|---|---|---|---|---|---|---|
| [illegible] | | | | | | | | | |
| [illegible] | | | | | | | | | |
| [illegible] | | | | | | | | | |

[illegible]

[illegible]

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[illegible]